



SMITHSONIAN INSTITUTION
U. S. NATIONAL MUSEUM

Vol. 98

Washington : 1949

No. 3234

A GENERIC REVISION OF THE TREEHOPPERS OF THE
TRIBE CERESINI IN AMERICA NORTH OF MEXICO,¹
BASED ON A STUDY OF THE MALE GENITALIA

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THE homopterous tribe Ceresini [original spelling Cerasini] Goding (1892, p. 256) contains those species of tree hoppers within the subfamily Similiinae that have the elytra free, with the clavus not covered by the pronotum. Fowler (1895, p. 87) has stated that "the Cerasini might, with reason, be further subdivided into three [tribes], Cyphoniini, Cerasini, and Acutalini." The Nearctic genera² form two natural groups on the basis of internal and external characters, thereby substantiating two of the three subdivisions suggested by Fowler; however, without a comprehensive study of Neotropical material, especially of Cyphoniini, it is believed wiser at this time to let Ceresini stand as one unit.

The genera have been accepted as morphologically distinct by previous workers, with the exception of *Ceresa* and *Stictocephala*, which have been distinguished from each other by the presence or absence of suprahumeral horns. The fallacy of using this character for separating the two genera has been the subject of considerable comment. Fowler (1895, pp. 87, 108) was the first to suggest separating *Ceresa* from *Stictocephala* by using characters of the male genitalia and proposed that species possessing an aedeagus with a much widened apex and having the styles short and obtuse be placed in the latter genus; however, *cornuta* Fowler (1895, p. 110) apparently

¹ The geographic limitation set forth here is not strictly followed, since much of the fauna of Mexico and Central America has been included when the material was available.

² For convenience in this discussion the term "Nearctic" is applied to any genus represented in the Nearctic region even though the majority of the species of the genus may be Neotropical.

is the only species in the "Biologia" whose generic position has been determined by this method.

Subsequently it has been generally agreed that the characters of the male genitalia may be used successfully to distinguish *Ceresa* and *Stictocephala*, but there are no practical applications of this principle in any published works. Van Duzee (1908, pp. 41-42) objected to the use of the characters of the male genitalia for distinguishing the genera but admitted that the present basis of separation is "purely artificial" and that "the two genera run into one another by insensible gradations," while Lawson (1922, p. 40) has suggested that "the genus *Stictocephala* should be divided, for the genitalia of *S. festina* and *S. lutea* cannot possibly belong to members of the same genus." Thus the idea has been developed that the division between *Ceresa* and *Stictocephala* and the composition of *Stictocephala* itself, as they now stand, are artificial and should be modified to form a more natural arrangement. The genus *Stictolobus* Metcalf (1916) is of comparative recent erection; therefore, it escaped comment in the earlier publications, and it was not represented in the fauna treated by Lawson.

In extending the investigation of correlation of genital and pronotal characters to include all the Nearctic Ceresini it has been found that the internal male genitalia of the species of *Ceresa*, *Stictocephala*, and *Stictolobus* form natural or similar groups not coincident with the divisions based upon pronotal characters. It is apparent that in this group of Ceresini a condition has been developed that has resulted in much confusion between superficial and basic relationships, and it would seem that our present interpretations of generic and specific relationships have been greatly influenced by the anterior pronotal characters (e. g., the metopidium and suprahumeral), which in the majority of cases probably have little real phylogenetic significance.

Funkhouser (1917, p. 314) has expressed his belief that the anterior pronotal characters are primarily specific in value and, in reviewing the possibility of using genital characters for classification of the Membracidae in general, states (p. 353):

Occasional attempts have been made to use the internal male genitalia for systematic purposes, but with little success. It is not unreasonable to believe, however, that these structures, which have proved of so much value in other groups of insects, should be equally distinctive in the Membracidae if the characters are patiently diagnosed for a large number of genera. It may naturally be supposed that sexual organs undergo less change when insects are forced into new conditions and environments than do motor or protective structures, and, being less plastic, would preserve their characters and readily yield themselves to generic classifications. A tentative study has seemed to show that this is indeed the case. The organs have become modified in form and have developed various types of claspers, styles, and prongs, but the necessity of retaining the function of the organs has kept these modifications within bounds.

While it may be highly improbable that this logic is applicable to all problems involving conflicting interpretations of pronotal and phallic characters or that the problems themselves have so simple a solution, at the same time this line of reasoning must form at least a part of the basic concept for evaluating the actual phylogeny because without it there is no rational approach to the correlation of the apparently conflicting evidence presented by phallic and pronotal characters. It must have been this conflicting evidence that prompted Buckton (1903, p. 18) to state, "The diversity of form and aptitude for variation appear in these organs [sexual organs] to be an embarrassment rather than an assistance in classification."

In this attempt to understand the probable relationships within the Ceresini it is realized that the evaluation and interpretation of phallic characters are not absolutely correct, but it is believed that the proposed arrangement is much more natural than the present system even though it is a radical departure from that system and is for the most part based upon only one sex. It is also realized that a restricted fauna as a basis for a generic revision is very inadequate; therefore, insofar as possible, the genotypes of Neotropical genera and as many other species as were available have been examined in an effort to eliminate errors. As a source of authentic material the majority of species examined in this work were determined by Dr. W. D. Funkhouser supplemented by specimens determined by the late Dr. E. D. Ball and Dr. F. W. Goding. Dr. W. E. China, of the British Museum, has kindly furnished illustrations of *Thelia lutea* Walker and supplied information concerning the type specimen. He has also stated that the type specimen of *Membracis vitulus* Fabricius originally described from the Drury collection is not in the British Museum.

Dr. E. C. Van Dyke has kindly supplied specimens from the California Academy of Sciences collection described and arranged by the late E. P. Van Duzee, including a cotype male of *Ceresa palmeri* Van Duzee labeled "Quinzelk; P. Q.; W. J. Palmer, 8-19-07." At the suggestion of Dr. Van Dyke this specimen is hereby designated the lectotype of *Ceresa palmeri* Van Duzee. M. A. Yothers has furnished all the correspondence and specimens that have been accumulated in his work on the treehoppers. Dr. C. C. Plummer has read the manuscript in its entirety and has offered helpful criticism and suggestions. To all these men, and to others within the Bureau of Entomology and Plant Quarantine who have given freely of their time for discussion and suggestions, the writer is indebted for assistance in preparation of this paper.

MORPHOLOGIC AND DIAGNOSTIC NOTES

The terminology used by Funkhouser (1917, pp. 352-363) in his discussion of the male genitalia has been followed in this paper, and no attempt has been made to enter into a detailed discussion of the morphology; however, the characters that have been considered as criteria for generic interpretation are outlined. The greatest consideration has been given to the form and structure of the aedeagus, which is fundamentally a U-shaped organ with the functional orifice on the posterior arm. Except *Acutalis*, *Micrutalis*, and *Parantonae*, there are four basic types of aedeagi represented in the Nearctic Ceresini: The U-shaped type with the posterior arm simple and slender; the U-shaped type in which the two arms are subequal in size with the posterior arm bearing an apical flap or otherwise variously modified; the trifurcate type, which has a bifurcate process at the base of the posterior arm; and the single arm type with the anterior arm greatly suppressed or not evident. These basic types may be subdivided into smaller groups according to less apparent morphological differences. It is believed that these basic types of aedeagi, and in most cases the subdivisions, possess fundamental characters for generic concept.

The styles fall into two groups: one in which the apices of the styles are vestigial and the other in which the apices are normally developed. The normally developed styles may be further divided into smaller groups on the basis of shape, form, and direction of projection. In most instances these groups are distinct and are associated with a definite type of aedeagus and, therefore, are of assistance in generic evaluation. The length of the teeth on the lateral valves is usually inversely proportionate to the development of the styles in that vestigial styles are accompanied by greatly developed teeth on the lateral valves and vestigial teeth are usually indicative of greatly developed styles. Since the differences in the form and the location of the teeth on the lateral valves can usually be associated with certain types of styles and aedeagi they are of generic value.

The genera *Acutalis*, *Micrutalis*, and *Parantonae* form a natural group apart from the other Nearctic Ceresini in that the apices of their styles are strongly recurved and project somewhat laterally toward the outside of the genital cavity, and their aedeagi are short and thickened. These three genera seem to represent natural divisions in that the phallic characters can be classified into three types that agree with the present generic concepts based upon external characters.

Almost all of the species cited in the generic review have been studied, their genitalia have been illustrated, and in genera primarily limited in distribution to the United States the species have been

briefly diagnosed. The synonymy, which is often extensive, has not been included because much of it may be found by referring to the "Catalogue" by Funkhouser (1927, pp. 179-233). It has been found in studying the genitalia of the various species of Membracidae that there is considerable variation within each species, especially if contrasted with other species of auchenorhynchous Homoptera; however, this variation is within definite limits, and the forms within the membracids are for the most part morphologically distinct and readily diagnosed. The form and size of the apical portion of the styles and the form and location of the teeth on the lateral valves are perhaps the most significant specific characters. The aedeagus is usually slightly different in each form, and in some groups it is sufficiently distinct for specific placement.

Several new forms are added to the list of described species. Where there is very little suggestion of close relationship to established species the new forms are considered to represent species. When the new forms are somewhat similar to established species they are treated as varieties when the two occur in the same territory, or if their ranges do not overlap or coincide then the new forms are believed to represent subspecies. Much more biological data are needed to ascertain the true nature of the forms in subspecific and varietal categories. The only genera in which color varieties are believed to be valid are *Acutalis* and *Micrutalis* where in most cases the color patterns are definite and the distribution of the varieties is such that there must be some correlation between the two.

GENERALIZATIONS ON PHYLOGENY

In order to have a starting point upon which to base the interpretations of the probable phylogeny of the Ceresini it is necessary to find the type of genitalia in the other Membracidae, especially in the Smiliinae, from which the more specialized genitalia of the Ceresini could have evolved. Not the most primitive in form for the Membracidae as a whole, but nevertheless the most common throughout the Nearctic genera, is that type of genitalia in which the lateral valves are present and unarmed, the aedeagus is a U-shaped organ, and the apices of the styles are strongly recurved dorsally and laterally. This type of genitalia is assumed to be the generalized type for the Smiliinae because it is the most simple and the most common, and it affords a convenient base from which it is possible to trace the deviations that occur in the Ceresini.

If the styles function as clasp ing organs, and this has been observed to be the case in several species studied by Funkhouser (1917, p. 362), then it may be reasonable to assume that any modification in their morphology affecting the efficiency of their function must have a

direct influence on the morphology of other organs or structures involved in copulation. It is probable that as the styles became less efficient for clasping their function was assumed in part or in full by some other organs or structures with a resulting modification of these parts, or it may be possible that other aids to clasping arose first and then the styles became less efficient or modified. Teeth on the lateral valves, and the spines or processes and other modifications of the aedeagus, are interpreted as functioning as clasping structures. The evidence supporting the aforementioned theories may be observed in the generic series of Ceresini where the arbitrarily generalized style unrolls, becomes flattened, shrinks in size, and then vanishes as the associated structures have become adapted for clasping. Since this specialized condition has not been observed in other genera of Nearctic Membracidae it is believed that the Ceresini, especially those with the veins of the corium united at the base, form a distinct and adventitious branch of the Membracidae. It is not known just where the specialization of the genitalia begins in this group nor is it known whether it is of singular or multiple origin; however, the more generalized type of genitalia occurs in *Parantonae*, *Micrutalis*, and *Acutalis*. *Parantonae* is perhaps more closely related to the Neotropical genera *Poppea* Stål and *Antonae* Stål than to any Nearctic genera although it may be distantly related to *Acutalis*. *Micrutalis* superficially resembles *Acutalis*, but the styles and aedeagi of the two are not similar and the relationship cannot be very close. I believe that *Micrutalis* is more closely related to the Neotropical genus *Brachytalis* Metcalf and Bruner, which in its present concept includes some species with minute teeth on the lateral valves. Some species of *Melusina* Stål and *Centrogonia* Stål, both Neotropical, have teeth on the lateral valves and the genera are distantly related to *Stictocephala* and to *Ceresa*, a genus restricted to the Neotropics. *Stictocephala* and *Tortistilis* both have similar aedeagi but are differentiated by the styles which are apically acute in the former and apically truncate or convergent in the latter. *Anisostylus* seems to be an isolated group suggestive of *Tortistilus* but is probably more closely related to *Spissistilus*. *Spissistilus* may well be the progenitor of *Vestistilus*, *Stictolobus*, and *Trichaetipyga*, as here the styles have definitely begun to shorten and in the last three genera the styles are more or less vestigial. *Vestistilus* is probably more closely related to *Spissistilus* than the other genera since the aedeagus is not too dissimilar while *Trichaetipyga* is probably further removed because the aedeagus in this genus is highly modified. *Stictolobus* seems to be a separate offshoot from *Spissistilus* not very closely related to *Vestistilus* or *Trichaetipyga*.

KEY TO THE MALES OF THE NEARCTIC GENERA OF CERESINI

1. Lateral valves and pygofers without teeth; apices of styles strongly recurved, divergent..... 2
 Lateral valves or pygofers with teeth; apices of styles vestigial or normal; if normal in length then apices are straight, convergent, or curved dorsally.. 4
2. Styles with apices obliquely truncate or barbed.....**Micrutalis** Fowler
 Styles with apices acuminate..... 3
3. Aedeagus with minute spines on anterior surface of posterior arm present for full length; lateral valves without tubercles.....**Acutalis** Fairmaire
 Aedeagus with large spines at apex of posterior arm on anterior surface; lateral valves with large rounded tubercles.....**Parantonae** Fowler
4. Aedeagus U-shaped, anterior and posterior arms subequal in length..... 5
 Aedeagus trifurcate or consisting of a single arm..... 10
5. Styles vestigial on apical half; teeth of lateral valves as long or longer than length of valves.....**Vestistilus**, new genus
 Styles normal on apical half; teeth of lateral valves shorter than length of valves, usually much so..... 6
6. Each lateral valve with two teeth, more dorsally placed tooth smaller than more ventrally placed tooth with surface of valve concave between; aedeagus much shorter than valves or styles, posterior arm finely dentate on anterior surface.....**Ceresa** Amyot and Serville
 Each lateral valve with one tooth; aedeagus as long as valves, posterior arm not dentate on anterior surface..... 7
7. Aedeagus with posterior arm simple, broader than anterior arm; functional orifice extending full length of posterior arm; styles usually strongly curved dorsally.....**Anisostylus**, new genus
 Aedeagus with posterior arm more slender than anterior; if arms are subequal in size then an apical flap or modification thereof is present on posterior arm..... 8
8. Styles broad, flat, slightly lunate on apical half; apices obtuse; posterior arm of aedeagus with apical flap or modification thereof..**Spissistilus**, new genus
 Styles long and acuminate apically; or S-shaped with truncate apices, or long with apices convergent..... 9
9. Styles long and acuminate apically; teeth on lateral valves as long or slightly longer than width of valves.....**Stictocephala** Stål
 Styles S-shaped with truncate apices, or long with apices convergent; teeth on lateral valves shorter than width of valves.....**Tortistilus**, new genus
10. Aedeagus appearing as a single tube or with anterior arm greatly suppressed.....**Stictolobus** Metcalf
 Aedeagus trifurcate; ventroposterior arm bifid....**Trichaetipyga**, new genus

Genus ACUTALIS Fairmaire

PLATE 18, FIGURE 3

Acutalis FAIRMAIRE, 1846, p. 496.

Similar to *Micrutalis* Fowler in general form but differing from that genus in that the venation of the elytra is distinct and five apical cells are present instead of three or four. The styles of the male somewhat resemble those in *Anisostylus*, new genus, but the lateral valves are unarmed and the aedeagus is of a more compact type. In general, the entire genitalia suggest close relationship to *Euritia* Stål and *Thrasymedes* Kirkaldy, which are tropical genera.

Pronotum low; lateral extensions knoblike; metopidium smooth; humerals slightly produced, obtuse; posterior process elongate, acute apically. Elytra with five apical cells; venation distinct, veins on corium separated at base. Lateral valves without teeth, usually narrow, elongate. Sternal plate with deep, broad, apical notch. Apices of styles acute, strongly recurved dorsally and laterally. Aedeagus short, with posterior arm much larger than anterior, with its anterior surface minutely dentate.

Type of the genus, *Acutalis fusconervosa* Fairmaire (1846, p. 498), a tropical species described from Colombia and occurring northward into Mexico. In the North American fauna only two species are structurally distinct and the other forms are believed to be color variations. The North American forms are listed:

- fusconervosa* Fairmaire, 1846
- tartarea* (Say, 1830)
- var. *inornata* Ball, 1905
- var. *nigrinervis* Fowler, 1895
- var. *semicrema* (Say, 1830)

Genus MICRUTALIS Fowler

PLATE 18, FIGURE 2

Microtalis FOWLER, 1895, p. 116.

Probably distantly related to *Acutalis* Fairmaire but more closely related to *Brachytalis* Metcalf and Bruner. Distinguished from either genus by the obscure venation of the elytra and the angular form of the styles and aedeagus.

Pronotum low; lateral extensions thin, platelike; metopidium smooth, very broadly rounded; suprahumeral smooth; humerals produced, obtuse; posterior process short, not constricted before obtuse apex. Elytra with three or four apical cells; venation obscure, veins on corium separated at base. Lateral valves almost as large or larger than pygofer, without teeth. Sternal plate deeply slit apically. Apices of styles abruptly directed dorsad; barbed on anterior margin. Aedeagus with arms subequal in size, angulate in lateral aspect; posterior arm with anterior and posterior margins parallel, posterior margin perpendicular to ventral margin, in lateral aspect.

Type of the genus, *Tragopa ephippium* Burmeister (1836, p. 191), a Neotropical species. Most of the species in this genus are small and lack morphological characters that may be used to distinguish one from another; however, in a few forms color characters seem to be consistent. These forms have been given varietal rank. The forms occurring within the United States are listed below:

- calva* (Say, 1830)
- var. *occidentalis* Goding, 1894
- var. *parva* Goding, 1894
- dorsalis* (Fitch, 1851)

Genus *PARANTONAE* Fowler

PLATE 18, FIGURE 1

Parantonae FOWLER, 1895, p. 101.

Easily separated from the other Nearctic genera by the greatly inflated sacs on the pronotum. Closely related to the Neotropical genera *Antonae* Stål and *Poppea* Stål from which it differs by the enlarged transversely globose sac located posteriorly on the pronotum followed by a single slender process.

Type of the genus, *Parantonae dipteroides* Fowler (1895, p. 102), a species from Guatemala. In this work only the male of *hispidata* Van Duzee, a species found in Arizona and California, has been available for study, and so it is impossible to formulate an accurate picture of the type of male genitalia characteristic for *Parantonae*. In general, however, the apices of the styles are acute, recurved, and strongly divergent. The posterior arm of the aedeagus is short and thick and bears rather stout spines on the anterior margin near the apex. Each lateral valve bears a prominent globose bump and this character, if not specific in nature, will serve to separate this genus from its closest relatives. All the known forms that have been described in this genus are listed:

- binodosa* Goding, 1926
- dipteroides* Fowler, 1895
- hispidata* Van Duzee, 1914
- ornata* Plummer, 1935

Genus *CERESA* Amyot and Serville

PLATE 18, FIGURE 5

Ceresa AMYOT and SERVILLE, 1843, p. 539.

As far as known this genus is not represented in the Nearctic fauna, although it comes as far north as Central America and southern Mexico. Because this genus has been differentiated from related genera, notably *Stictocephala* Stål, by the single criterion of the presence of suprahumeral horns it has been erroneously assumed that our common North American species of *Stictocephala* belong in this genus. The genus as here redefined, with greater weight placed upon the value of genital characters, is not represented in the Nearctic and the great majority of our North American *Ceresa* belong in *Stictocephala* while most of the South American forms will remain in *Ceresa*.

The type species, *Membracis vitulus* Fabricius (1775, p. 677), originally described from South American material in the Drury collection, has not been examined and the interpretation of this species has been based on Brazilian material answering in so far as possible to the descriptions given by Fabricius, Fairmaire, Stål, and Fowler.

In the collection of the U. S. National Museum are specimens determined by Funkhouser and Goding as *vitulus* Fabricius that fit the meager definition of that species. A plesiotype male has been selected from this material upon which is based the specific concept of *vitulus* and the generic concept of *Ceresa*. The generic concept of *Ceresa* has been further fortified by a study of other forms congeneric with *vitulus*.

Metopidium vertical, rounding posteriorly, slightly transversely rounded, very broad. Suprahumeral greatly developed into long, acute horns, somewhat curved posteriorly. Pronotum greatly narrowed behind humeral angles; sides almost vertical; dorsal ridge very acute, posterior process elongate, acute.

Sternal plate narrowed in apical half. Lateral valves with apical portions produced into small acute teeth in addition to elongate lateral teeth. Lateral teeth arising near centers of anterior margins of valves, curved somewhat dorsally. Styles thickened, usually elongate; apices variously modified according to the species, usually suddenly narrowed near apices. Connective between styles and aedeagus almost as long as aedeagus. ("Style-aedeagus connective" of Lawson, 1922, p. 39.) Aedeagus with arms subequal in length; posterior arm more slender than anterior; anterior surface of posterior arm finely and densely dentate; opening very broad, extending almost for full length of posterior arm.

CERESA VITULUS (Fabricius)

Membracis vitulus FABRICIUS, 1775, p. 677.

Approximately 10 mm. in total length; width across suprahumeral horns 6 mm. White, arched, lateral stripes present on sides of pronotum. (These stripes are more prominent on some specimens than others.) Elytra yellowish-tinted. Styles of male with suddenly constricted apices, heavily pilose, strongly convergent.

Male plesiotype from Pará, Brazil.

Genus STICTOCEPHALA Stål

PLATE 18, FIGURE 4

Stictocephala STÅL, 1869, p. 24.

Resembling *Ceresa* in general appearance but apparently not closely related. Similar to *Tortistilus*, new genus, in the form of the aedeagus but lacking the flattened convergent styles of that genus and possessing a pronotum that is much lower anteriorly.

Suprahumeral either smooth or developed into horns. Metopidium sloped or curved posteriorly. Male styles in apical half round or oval in cross section, sometimes slightly curved dorsally, acuminate apically. Aedeagus with functional orifice long, narrow, subapical;

apex of posterior arm acuminate in lateral aspect, appearing flattened in caudal aspect.

Type of the genus, *Thelia lutea* Walker (1851), from North America. Because the Walker specimens are cotype material it is desirable to designate one specimen as type. Funkhouser (1923, p. 113), in referring to the figure of *lutea* drawn by Knight, made the following statement: "We should consider the form as figured by Mr. Knight as typical." It is believed that this statement cannot be rigidly construed as type fixation, and furthermore, it is uncertain which of Walker's specimens was figured; however, according to W. E. China,³ it is believed to be specimen "a" (Walker, 1851, p. 560), which is a female. I believe the specimen figured by Knight to be *festina* (Say), because a proportionate drawing of *festina* superimposed over the illustration by Knight is too nearly perfect for the two not to be the same species. If this belief is true then Walker's original description of *lutea* cannot be based on specimen "a," as the colors mentioned in the description do not occur in *festina*. W. E. China has stated further that specimen "c," a male, bears a type label (labeled before his time) and is conspecific with specimen "b," which is also a male. In order to validate the labeled type of the Walker material I hereby designate specimen "c" as lectotype male of *Thelia lutea* Walker.

With few exceptions the majority of the species occurring in the Nearctic that were included in *Ceresa* will now be included in *Stictocephala*. As far as known the genus is limited in its distribution to the Nearctic region of North America and undoubtedly occurs in northern Mexico and in the higher elevations farther south, but there are no records of any species from Mexico. The life histories and partial biologies worked out for a few forms would indicate that oviposition occurs on woody plants and that the development of the immatures occurs on succulent herbaceous vegetation.

Stictocephala is closely related to *Tortistilus* through *lutea*, *substriata*, and *diminuta* which resemble the forms of *Tortistilus* that occur on cypress. *S. abnormalis* and *S. curvata* also have styles that are suggestive of those possessed by species of *Tortistilus*.

In general, the male genitalia of the species appear to be well defined and subject to little variation. The style type associated with the species of this genus is simplified and tubular in form, and the differences between many forms are not outstanding; however, by making use of the prominent characters displayed by the body in general and the thorax, such as color and development of the supra-humerals, supplemented by characters found in the genitalia, the forms can be differentiated without too much difficulty.

S. diceros and *S. albescens* are differentiated from the other forms

³ In correspondence.

by color; both are brown with *dicerus* displaying two light bands on the pronotum and *albescens* only one band. *S. basalis* is the only species with the entire venter jet black, and sometimes the entire body is more or less blackened. *S. lutea*, *substriata*, and *diminuta* are the only forms without suprahumeral horns. *S. substriata* has the lateral valves produced dorsally beyond the pygofers and the teeth on the valves are very thick, while *lutea* and *diminuta* have normal lateral valves with slender teeth. The styles in *lutea* are smooth beneath apically while those of *diminuta* are serrate beneath. *S. brevicornis* and *curvata* have the suprahumeral horns very minute and the metopidium is evenly convex in dorsal aspect. The styles in *brevicornis* are evenly curved for full length, while those of *curvata* are abruptly curved in the apical fourth. The teeth on the lateral valves are broadly rounded apically in *brevicornis* and apically acute in *curvata*. *S. palmeri* is characterized by the presence of a basal ring on the posterior arm of the aedeagus. *S. tauriniformis* is the only species with the teeth of the lateral valves very suddenly narrowed and stylate in the apical third. *S. militaris* and *abnorma* are unusual in the elongate form of the genitalia; the sternal plate is as long or longer than the rest of the abdomen in either species. The styles in *abnorma* are strongly curved in the apical fourth, while in *militaris* they are straight throughout. *S. brevis*, *brevitylus*, and *stimulea* have in common a strongly convex metopidium with the suprahumeral horns continuing the line of the metopidial curve and projecting somewhat posteriorly. In *brevis* the teeth of the lateral valves are abruptly bent inward in the apical third while the last two species have straight teeth. *S. stimulea* is a larger species than *brevitylus* and has the functional orifice not reaching to the apex of the aedeagus while *brevitylus* has a functional orifice extending to the apex of the aedeagus. *S. bubalus* is the largest and most robust species of the genus with a very broad metopidium. Often a small dark spot is present on the pronotum near the apex of the posterior process that will assist in distinguishing *bubalus* from the other species.

S. taurina resembles *tauriniformis* in that both forms have a very low pronotum with the suprahumeral horns relatively short, acute, and slightly recurved apically; however, the teeth of the lateral valves in *taurina* are gradually acute apically and are not suddenly narrowed as in *tauriniformis*. In the present concept, *taurina* seems to be a complex of at least two variable forms between which this writer is unable to distinguish. If *taurina* represents one biological unit, then it is subject to great variation throughout its extensive range. *S. taurina*, as characterized by Fitch's type, has the teeth of the lateral valves very acute apically, the styles evenly curved in lateral aspect and convergent in the apical third in ventral aspect. The extreme of the other

form has the teeth of the lateral valves rounded or obtuse apically, the styles with their apices deflected ventrally in lateral aspect and evenly convergently curved in ventral aspect. This latter form is slightly larger than typical *taurina*, but all the characters that might serve to differentiate the two forms are gradational in an extensive series of specimens. It is well to note here that the specimen in the U. S. National Museum, labeled type of *illinoiensis*, is conspecific with typical *taurina*; therefore, *illinoiensis* is a synonym of *taurina* and is not a synonym of *constans* (Walker) as believed by Van Duzee; however, there is a specimen labeled "*illinoiensis* n. sp." in the U. S. National Museum collection that is conspecific with *constans*.

The interpretation of *borealis* is based on specimens determined by Funkhouser that fit the meager description given by Fairmaire. It is a small, short-horned species occurring across northern United States from the Atlantic to the Pacific coast and as far south as Arizona. The styles are slender and deflected ventrally at their apices, and the posterior arm of the aedeagus is more slender in proportion to the size of the entire insect than in other species.

STICTOCEPHALA CURVATA, new species

PLATE 20

Length, male 8.8 mm., female 9.6 mm.; width across horns approximating 3.8 mm. in either sex. General color of dried specimens orange-yellow, suprahumeral horns tipped with polished black.

Thorax highly arched; metopidium widening to suprahumeral, roundedly curved from suprahumeral to dorsal crest; suprahumeral produced into minute, obtuse horns; posterior process continuing curve of crest, narrowed from ventral margins well before apex.

Male with teeth of lateral valves slender, acute. Sternal plate deep basally, apex with very small but sharp V-shaped notch. Styles concave basally in lateral aspect, strongly convergent apically in ventral aspect; apices flattened, broadly rounded. Posterior arm of aedeagus suddenly narrowed apically in lateral aspect; lateral membranes on either side somewhat serrate; a small hoodlike process present subapically on anterior surface formed by union of lateral membranes.

Last ventral segment of female with broad notch in center of posterior margin reaching half the depth of the segment; sides of notch broadly sinuate.

Holotype male (U.S. N. M. No. 57640), three male paratypes, female allotype, and four female paratypes from "Carns," Nebr., July 1902, on *Symphoricarpos* (Pierce); and one male paratype, "C. Mc.," July.

Similar in appearance to *brevicornis* (Fitch) but with much smaller suprahumeral and different genitalia.

STICTOCEPHALA ABNORMA, new species

PLATE 20

Superficially resembling *borealis* (Fairmaire) but with the pronotum more arched. Closely related to *militaris* (Gibson and Wells) in structure of the genitalia but differing from that species by the more acute teeth on the lateral valves and by the caliperlike styles.

Length, male 7.2 mm., female 7.5 mm.; width across horns, male 3.8 mm., female 4.2 mm. General color of dried material yellow washed with green; sides of pronotum spotted with white.

Pronotum highly arched; metopidium flat from horns to dorsal crest; humerals little produced; suprahumeral produced into blunt horns; posterior process gradually narrowed, acute apically.

Male with lateral valves elongate, narrow; teeth arising from upper fourth, as long as width of valves, acute apically. Sternal plate narrow, elongate, acute V-shaped notch in apical margin. Styles almost three times as long as aedeagus, caliperlike in apical third in ventral aspect, S-shaped in lateral aspect. Connective from styles to aedeagus as long as aedeagus.

Last ventral segment of female with broad V-shaped notch in center of posterior margin.

Male holotype (U.S.N.M. No. 57641), three male paratypes, female allotype, and one female paratype from Concan, Tex., June 4, 1933 (Oman); one male and one female paratype from Brownwood, Tex., May 29, 1941 (Christenson).

STICTOCEPHALA TAURINIFORMIS, new species

PLATE 21

Resembling *taurina* (Fitch) but with lower and flatter pronotum. Somewhat similar to *palmeri* (Van Duzee) in general appearance but with longer horns; differing from any related species by the suddenly narrowed apices of the teeth on the lateral valves.

Length, male 7.2 mm., female 7.5 mm. General color of dried material green. Triangle formed by metopidium above the bases of horns red brown, dorsal crest of same color. Lateral areas along each side of dorsal crest maculate with large white spots.

Pronotum very low, little arched, coarsely pitted; metopidium with sides parallel in frontal aspect; suprahumeral horns somewhat flattened dorsoventrally, acute apically, projecting slightly upward from horizontal, strongly recurved posteriorly; posterior process elongate, slender, not declivent.

Male with teeth on lateral valves suddenly convergent and narrowed in apical fourth. Sternal plate with deep, acute, V-shaped apical notch. Styles with apical portions divergent in basal fifth, very

gradually convergent in apical four-fifths. Posterior arm of aedeagus with lateral membranes forming a small hoodlike, subapical process where they converge on the anterior surface.

Last ventral segment of female with parabola-shaped notch in center of posterior margin almost as deep as segment.

Male holotype (U.S.N.M. No. 57642) and male paratype, Sioux County, Iowa, June 29, 1932 (Moore); female allotype, Story County, Iowa, July 5, 1932 (Russell); two male and one female paratypes, Ames, Iowa, July 4, 1919 (Ball); male and female paratype, Ames, Iowa, June 30 and July 28, 1897, respectively; male and female paratype, Clearmont, Iowa, August 3, 1929 (Rolfs); one male paratype, Mercer, Wis., 1910 (Chandler), and one, Toronto, Ontario, 1896 (Hills); male paratype, Lehigh Gap, Pa., July 20, 1902 (Greene); female paratype, Amery, Wis., September 14, 1917 (Ball); four female paratypes, Illinois, September 16, 1888; female paratype, Urbana, Ill., September 25, 1901; and one female paratype, Washington, D. C., July 2, 1917 (Taylor).

STICTOCEPHALA BREVITYLUS DOLICHOTYLUS, new variety

PLATE 21

Resembling the more slender examples of typical *brevitylus* (Van Duzee) but with the tylus elongate and only slightly curved posteriorly.

Length, male 8 mm., female 8.4 mm. Face yellow. Pronotum green mottled with yellow. Yellow color forming a broken irregular stripe along lateral ridges of metopidium and along dorsal crest. Horns tipped with black. An orange stripe present on ventral surface of either horn extending across pronotum to each eye.

Tylus elongate, slightly curved posteriorly. Metopidium not widening to suprahumeral horns as in typical *brevitylus*, less convex in dorsal aspect. Styles in male less abruptly bent at bases of apical portions in lateral aspect. Last ventral segment of female with deeper notch than in typical form.

Male holotype (U.S.N.M. No. 57643) and female allotype from Babylon, Long Island, N. Y., August 15, 1933 (Blanton), and a male and a female paratype from "New York."

All the known forms are listed below:

abnorma, new species

albescens (Van Duzee, 1908), new combination [*Ceresa*]

basalis (Walker, 1851) new combination [*Ceresa*]

borealis (Fairmaire, 1846), new combination [*Ceresa*]

brevitylus (Van Duzee, 1908), new combination [*Ceresa*]

dolichotylus, new variety

brevicornis (Fitch, 1856), new combination [*Ceresa*]

brevis (Walker, 1851), new combination [*Ceresa*]

bubalus (Fabricius, 1794), new combination [*Membracis*, *Centrotus*, *Ceresa*]

curvata, new species

dicerus (Say, 1824), new combination [*Membracis*, *Smilia*, *Ceresa*]

diminuta Van Duzee, 1908

lutea (Walker, 1851)

militaris (Gibson and Wells, 1917), new combination [*Ceresa*]

palmeri (Van Duzee, 1908), new combination [*Ceresa*]

stimulea (Van Duzee, 1909), new combination [*Ceresa*]

substriata (Walker, 1851)

taurina (Fitch, 1856), new combination [*Membracis*, *Enchenopa*, *Ceresa*]

illinoiensis (Goding, 1894), new synonymy [*Ceresa*]

tauriniformis, new species

TORTISTILUS, new genus

PLATE 18, FIGURE 6

In general resembling *Stictocephala* Stål but differentiated by having the metopidium more vertical and by having the styles of the males more flattened with their apices truncate or strongly convergent.

Suprahumeral usually prominent but usually unarmed. Metopidium almost vertical; the sides meeting before the middle of the body. Lateral valves with teeth; teeth shorter than width of valves. Male styles flattened in apical half, S-shaped; apices obliquely truncate or convergent. Aedeagus with functional orifice long, narrow, subapical; apex of posterior arm acuminate, needlelike in lateral aspect, appearing slightly flattened in caudal aspect.

Type of the genus, *Membracis goniphora* Say (1830, p. 243), known to occur over the northern section of the United States. The selection of *goniphora*, which is a synonym of *inermis* Fabricius, for type may be an unusual procedure, but it is believed to be the more logical choice since it is known that Say's material came from the Missouri region while it is only problematical that the Fabrician material may have come from northern North America. Furthermore, *goniphora* Say is the only large ceresine lacking suprahumeral horns other than *Membracis festina* Say recorded from the Missouri region, so it is reasonably certain that the specific identification of *goniphora* is correct even though its type is destroyed. In order to have a specimen upon which to base the specific concept of *goniphora* and the generic concept of *Tortistilus* it becomes necessary to designate a neotype for *Membracis goniphora* Say.

TORTISTILUS INERMIS (Fabricius), new combination

Membracis inermis FABRICIUS, 1775, p. 677.

Membracis goniphora SAY, 1830, p. 243.

Length 8.5 mm., greatest width 3.4 mm. General color of dried specimen dark yellow washed with green along suprahumeral and dorsal crest; lateral areas of pronotum spotted with white. Femora with dense black subapical areas; tibiae and tarsi lightly fumate.

Pronotum greatly elevated; metopidium perpendicular, widening to prominent rounded suprahumeral, the sides meeting before middle of body; posterior process gradually acuminate apically, strongly declivent, extending beyond the abdominal apex.

Lateral valves of males with teeth shorter than width of valves; teeth arising just dorsad to center of anterior margins of valves. Sternal plate with small apical notch. Styles long, S-shaped, appearing caliperlike in ventral aspect; apices flattened, truncate, minutely serrate. Aedeagus with posterior arm much more slender than anterior; functional orifice subapical, elongate-oval.

Description based on male neotype from Jefferson City, Mo., June 30, 1940 (Adams).

Members of *Tortistilus* are known to occur only in the Nearctic region, and as far as known their life cycles approximate those of *Stictocephala* in that the egg stage is passed upon a woody host and the immatures develop upon herbaceous plants. Many of the species are of economic importance in apple culture; *inermis* was reported as a major pest in the Pacific Northwest by Yothers, 1934.

Since the aedeagus in this genus is the same as that in *Stictocephala* it is possible that it should not be considered generically distinct; however, the styles of the two groups are very dissimilar and in general the thoracic profiles are very different, so the two groups are herein considered to represent two distinct genera.

The inclusion of *lateralis* (Funkhouser) and *trilineatus* (Funkhouser) in *Tortistilus* may be questioned because they differ from other species in this genus by slight differences in the aedeagus, styles, teeth on the lateral valves, pronotal profile, and the fact that they both occur on cypress. While it is recognized that the forms on cypress represent a distinct branch of *Tortistilus* it is believed that this branch is not far enough removed to be considered as generically distinct.

T. inermis, *collinus*, *pacificus*, and *wickhami* comprise a difficult but very interesting group. The apices of the styles in these forms are subject to considerable variation in form and size; however, this variation has a limited range for each species and as a whole the apices are very pertinent for specific diagnosis.

The variability of the styles in *inermis* received comment from Lawson, 1922, who illustrated (pl. 4, figs. 1, 5, 8) three different examples. Throughout the species it seems that specimens from one locality differ slightly from specimens of the same species from another locality with these differences being more pronounced in material from mountainous areas.

T. minutus is characterized by the low pronotum and by the tooth-like projection at the inner apical angle of the styles. *T. collinus* is readily separated from the related forms by the greatly suppressed suprahumeral and by the styles that are similar in form but larger

apically than those in *inermis*. *T. inermis* has a much broader metopidium than either *pacificus* or *wickhami* and is never black on the abdominal venter, whereas the two latter forms usually exhibit a tendency to be black beneath. The styles in *inermis* are not greatly enlarged apically and are minutely serrate. In *pacificus* and *wickhami* the styles are not minutely serrate and are greatly produced at the inner angles in *wickhami*; and in *pacificus* they are greatly enlarged apically and almost equally produced at the outer and inner angles.

T. wickhami is more northern in distribution than *pacificus* and its occurrence in California is probably determined by the higher elevations. *T. pacificus* is the commonest species in California, apparently replacing *inermis* in this State, which might suggest a subspecific relationship; it extends northward into southern Oregon and eastward through Nevada into Utah.

T. albidosparsus is separated from the other forms by having the suprahumeral developed into horns. The outer apical angles of the styles are acute and usually strongly produced. A form possessing very long horns and having the outer and inner apical angles of the styles strongly produced is described as a new variety.

TORTISTILUS MINUTUS, new species

PLATE 22

Superficially resembling *wickhami* (Van Duzee) but much smaller, with a lower pronotum and with the metopidium more rounded posteriorly.

Length, male 6.2 mm., female 6.6 mm. General color of dried specimens dark yellow mottled with irregular orange spots; coxae in the males blackened on outer side.

Pronotum low. Metopidium perpendicular on basal half, apical portion rounding posteriorly; the sides little widened before the suprahumeral, meeting at a point one-third the length of pronotum from anterior extremity. Posterior process very strongly declivent.

Male with teeth of lateral valves less than twice as long as broad, broadly rounded apically. Sternal plate laterally compressed in apical half to one-half of the basal width; apical fifth split, a small notch present at extreme apex. Styles long S-shaped; apices flattened, obliquely truncate, slightly serrate, outer and inner apical angles about equally produced with inner angle toothlike. Anterior arm of aedeagus greatly narrowed in apical third in either lateral or posterior aspect; functional orifice very broadly ovate.

Last ventral segment of female with posterior margin broadly emarginate, small V-shaped notch present in middle.

Male holotype (U.S.N.M. No. 57644), female allotype, one male paratype, and five female paratypes from "Montana," Uhler collection; one male paratype "Dac." (Dakota), Uhler collection.

TORTISTILUS ALBIDOSPARSUS BUBALIFORMIS, new variety

PLATE 22

Length, male 8 mm., female 8.8 mm.; width across horns approximating 4.7 mm. in either sex. Yellowish mottled with white. Horns tipped with black, with mahogany-colored stripes beneath not quite reaching humerals; short reddish stripe present on dorsoposterior margin; a white stripe separating the two dark red stripes on each horn continued onto the sides of the pronotum but fading before the ventral margins of the pronotum.

Metopidium broad, slightly convex below horns, forming a broad flattened triangle between and posterior to horns. Horns recurved, acute.

Styles in male tending to be truncate with outer and inner apical angles equally produced into acute points.

Last ventral segment in female deeply notched in center of posterior margin; sides of notch sinuate.

Resembling *Stictocephala bubalus* (Fabricius) in general appearance but differentiated by the flattened apically truncate styles. Related to *T. a. albidosparsus* (Stål) but with longer horns and with the apical angles of the styles equally produced.

Male holotype (U.S.N.M. No. 57645), male paratype, and female allotype from Beaumont, Calif., June 23, 1941 (Christenson), on alfalfa; two male and two female paratypes from Oak Glen, Calif., August 29, 1939 (Christenson), on alfalfa; a male and female paratype from "Pasadena, Calif., 8-28"; and one male paratype from San Gabriel, Calif. (Hutchinson).

The forms occurring on cypress are a compact group comprising at least two distinct species and possibly several subspecies. The series of specimens are too short and the locality records are too limited to permit one to arrive at a definite conclusion as to whether these forms are subspecies replacing the typical forms in certain localities or whether they represent varieties. Since these forms are morphologically distinct but somewhat similar to the typical species they are herein considered to be varieties.

TORTISTILUS TRILINEATUS CALIPERUS, new variety

PLATE 22

Superficially resembling *T. t. trilineatus* (Funkhouser) but with a ratio of total length to length of pronotum as 7.1 is to 4.3; in *t. trilineatus* this proportion is 7.1 to 5.9.

Posterior process short, rather obtuse, very slightly declivent, equilaterally triangular in cross section. Styles of male angular, acute apically, strongly convergent, caliperlike. Last ventral segment of female almost as long as three preceding sclerites combined, notch in center of posterior margin extending almost to the base.

Male holotype (U.S.N.M. No. 57646) and male paratype from Sanford, Fla., June 9, 1926; two male paratypes same locality, July 8, 1926, female allotype and female paratype, June 17, 1947, and one female paratype, July 8, 1926 (Ball).

TORTISTILUS TRILINEATUS CURVATUS, new variety

PLATE 22

Ratio of total length to length of pronotum approximating that of *t. caliperus*, new variety. Posterior process more acute and more declivent, similar to *t. trilineatus* (Funkhouser), but differing from either by the truncate styles of the male.

Styles broad, flat, suddenly convergent apically; apices broadly truncate, slightly concave; inner margins produced subapically. Last ventral segment of female as long as three preceding sclerites combined; notch in center of posterior margin extending almost to base; basal half of notch acute, V-shaped; apical portion of notch widening to lateral margins of segment.

Male holotype (U.S.N.M. No. 57647) and six male paratypes from Concan, Tex., June 4, 1933 (Oman); paratype male, female allotype, and three female paratypes from Kerrville, Tex., June 9, 1907 (Pratt).

TORTISTILUS TRILINEATUS SIMILIS, new variety

PLATE 22

Form and proportion of *t. trilineatus* (Funkhouser) with an acute, deflected posterior process. Differing from the typical form by having the male styles somewhat apically convergent and truncate.

Styles in male convergent in apical tenth; apices truncate, slightly serrate. Last ventral segment of female as long as three preceding segments; sharp, V-shaped notch present in center of posterior margin half as deep as length of segment.

Holotype male (U.S.N.M. No. 57648), male paratype, female allotype, and five female paratypes from Pickens, Miss., July 16, 1921 (Drake); two male paratypes and one female paratype from Natchez, Miss., July 25, 1921 (Drake).

All the known forms are listed below:

albidosparsus (Stål, 1859), new combination [*Ceresa*]

bubaliformis, new variety

collinus (Van Duzee, 1908), new combination [*Stictocephala*]

inermis (Fabricius, 1775), new combination [*Membracis*, *Ceresa*, *Smilia*, *Stictocephala*]

*lateralis*⁴ (Funkhouser, 1936), new combination [*Stictolobus*]

minutus, new species

pacificus (Van Duzee, 1908), new combination [*Stictocephala*]

⁴ Since completion of this work, I have examined the type of *lateralis* from Horseshoe Lake, Ill., and find it to be a different species from the paratype in the U. S. National Museum.

- trilineatus* (Funkhouser, 1918), new combination [*Stictolobus*]
caliperus, new variety
curvatus, new variety
similis, new variety
wickhami (Van Duzee, 1908), new combination [*Stictocephala*]

ANISOSTYLUS, new genus

PLATE 19, FIGURE 8

Superficially resembling *Spissistilus*, new genus, but with a lower and broader metopidium with suppressed suprahumeralis suggestive of *Acutalis* Fairmaire.

Pronotum low; metopidium broader than high; suprahumeralis usually suppressed but if present (as indicated by slight swellings) then located very close to the humeral angles; posterior process greatly extended posteriorly on a line even with the apex of the apical cell in the forewing. Lateral valves broadly ovate with teeth longer than width of valves. Styles usually broad and curved dorsally but sometimes narrow, greatly elongate and strongly curved. Aedeagus with posterior arm simple, rounded apically, with functional orifice a broad slot extending from apex almost to base; attachment of posterior arm to anterior arm much above base of latter; anterior arm subequal in size to posterior arm, sometimes with an anterior plate making the total width greater than that of the posterior arm.

Type of the genus, *Stictocephala fulgida* Ball (1937, p. 480), from southern Arizona. *Stictolobus viridis* Funkhouser (1943) is herein considered to be a synonym of *fulgidus* (Ball) since there is nothing to differentiate the two forms and both have been collected in the same general locality. The type female of *Stictocephala gillettei* Goding very closely resembles the occasional female specimens of *Membracis festina* Say that have the suprahumeralis suppressed. Because it is impossible to determine the suggested synonymy definitely and a species of *Anisostylus* does occur in Colorado [type locality of *gillettei*] that is very similar, *gillettei* is considered a valid species. A form of *Anisostylus* occurring in New Mexico that is morphologically distinct from *fulgidus* is believed to be a subspecies, and a highly differentiated form occurring in Utah and Idaho is described as new. *Stictocephala elongata* Fowler (1895, p. 110), a Mexican species, may belong in *Anisostylus*.

ANISOSTYLUS FULGIDUS ELONGATULUS, new subspecies

PLATE 22

Differing from typical *fulgidus* (Ball) by the more elongate form, more angulate metopidium, and by the apices of the male styles rounding to the inner margins instead of rounding to the outer mar-

gins. Length, male 7.6 mm., female 7 mm. Specimens from preserving fluid, color unknown.

Thorax low; metopidium produced anteriorly before rounding posteriorly, slightly angulate toward center instead of evenly rounded in dorsal aspect; suprahumeral completely suppressed; humerals prominent; sides of pronotum sharply and deeply cut away just posterior to humerals; posterior process not strongly deflected.

Teeth on lateral valves of male, slender, convergent apically. Sternal plate with broad, shallow, apical notch; lobe on either side of notch broadly rounded. Styles very broad, flat, elongate, strongly curved dorsally, acute apically; outer margins of apices rounded to straight inner margins. Posterior arm of aedeagus gradually narrowed to rounded apex. Last ventral segment of female with broad U-shaped notch in center of posterior margin.

Male holotype (U.S.N.M. No. 57649) and female allotype from Espanola, N. Mex., August 29, 1940 (Christenson), and one female paratype, Santa Fe, N. Mex., "Oct. 4" (Cockerell).

ANISOSTYLUS STYLATUS, new species

PLATE 22

Resembling *fulgidus* (Ball) from which it is easily separated by its more robust form and long slender styles in the male.

Length, male 5.7 mm., female 6.2 mm. Pronotum dark green; apex of posterior process dark orange. Face and entire venter yellow, abdomen black above.

Thorax low; metopidium broadly transversely rounded; suprahumeral indicated by slight swellings; humerals prominent, obtuse; sides of pronotum behind humerals gradually and shallowly narrowed; posterior process reaching to a point in line with the posterior end of apical cells in elytra, strongly deflexed in male, less so in female.

Male with teeth of lateral valves acute apically. Sternal plate with sharp apical notch; lobes on either side of notch narrowly rounded. Styles slightly flattened, very elongate, strongly curved dorsally; apices acute, deflected caudally. Posterior arm of aedeagus gradually narrowed apically to rounded apex. Last ventral segment of female with broad, deep notch in center of posterior margin.

Holotype male (United States National Museum No. 57650), Avon, Utah, May 29, 1939 (Knowlton); female allotype, Laketown, Utah, April 11, 1935 (Sorenson); male paratype, Garland, Utah, September 4, 1935 (Knowlton), male paratype, Logan, Utah, September 7, 1906 (Ball), and male paratype, Ridale, Idaho, April 17, 1934 (Smith).

The forms known to occur in the United States are listed:

fulgidus (Ball, 1937), new combination [*Stictocephala*]
viridis (Funkhouser, 1943), new synonymy [*Stictolobus*]
elongatulus, new subspecies
gillettei (Goding, 1892),⁵ new combination [*Stictocephala*]
stylatus, new species.

SPISSISTILUS, new genus

PLATE 19, FIGURE 7

Made up of species formerly included in *Ceresa* Amyot and Serville and *Stictocephala* Stål but differing from both genera by the reduction in size of the male styles and the highly modified aedeagus. The members of this group are relatively small compact species that have the suprahumeral prominent and frequently developed into small horns.

Pronotum low; suprahumeral usually very prominent, small horns sometimes present; metopidium broad, rounded transversely and posteriorly. Teeth on lateral valves as long as narrowest width of valves; arising near ventral margins of valves. Styles of male with apical portion broad, flat, slightly lunate; apices obtuse. Aedeagus usually with functional orifice apical; knob or flaplike extension present on apical margin above orifice usually small but sometimes greatly enlarged or variously modified.

Type of the genus, *Membracis festina* Say (1830, p. 243), originally described from Florida, is one of the most common, abundant, and well known species occurring in the southern sections of the United States. Several varieties have been established on characters of color and form of the suprahumeral, but these characters are gradational and do not warrant varietal consideration. The type specimen has been lost and a neotype is designated.

SPISSISTILUS FESTINUS (Say), new combination

Membracis festina SAY, 1830, p. 243.

Length 6 mm., width across suprahumeral 2.4 mm. General color of dried specimen deep orange with suprahumeral and dorsal crest light red.

Pronotum low, deeply pitted; metopidium widening to flaring suprahumeral, rounded posteriorly, sides meeting posterior to middle of body; suprahumeral very prominent; posterior process suddenly narrowed, elongate, acute apically.

Teeth of lateral valves arising from center of lower third of valves, flattened laterally, curved ventrally and convergent apically. Sternal plate with shallow apical notch. Apical portion of styles greatly flattened laterally, short, semilunate, obtuse apically. Posterior arm of aedeagus tubular in form, longer than anterior arm; small transverse apical flap present above functional orifice which opens apically.

Neotype male from Daytona, Fla., June 3, 1928 (Ball).

⁵ *Viridis*, *nomen nudum*, an obvious error for *gillettei*. Goding (p. 11).

Within the species of this genus the suprahumeral in both sexes and the genitalia of the male are subject to small variations. *S. festinus* has an extensive range across southern United States and as far south as Costa Rica. The suprahumeral in this species are sometimes greatly suppressed or sometimes strongly developed, forming small horns. Horned individuals may be confused with *occidentalis*, but the development of the horns is never as pronounced as in *occidentalis* and the styles in *occidentalis* are slenderer and much more narrowed at midlength than in *festinus*.

For the present *franciscanus* is retained as a valid species since the thorax is lower, the methopidum more rounded, and the styles more serrate than in *festinus*. The interpretation of *franciscanus* is based on specimens determined by Van Duzee (1908, pp. 48, 49). *S. nigricans* seems to be a color variety of *franciscanus* since there are no consistent structural characters that will differentiate the two forms. It is interesting to note that *franciscanus* has been reported by Yothers (1941, p. 1) as ovipositing on orchard trees, while its close relative, *festinus*, according to Wildermuth (1915) completes its life cycle on alfalfa.

S. rotundatus may be a subspecies of *festinus* occurring in insular America as the two forms are very close; however, the styles in *rotundatus* are broadly sinuate on their dorsal margins while in *festinus* they are evenly arcuate.

S. cornutus is placed in this genus by the authority of Fowler's (1895, p. 110) observation as to the type of genitalia. This writer has seen one specimen that probably belongs to this species. Observations based on specimens from the Biologia Centrali-Americana material that are in the collection of the U. S. National Museum reveal that *fuscus* and *dubius* are color varieties of *festinus*.

S. femoratus has been reported ovipositing on orchard trees in the United States, but there are no specimens of this species in the U. S. National Museum collection from north of Mexico, D. F. Probably *uniformis* is conspecific with *femoratus*, but there is no evidence to substantiate this supposition other than the inadequate description by Fairmaire which indicates that it may be a color variety of *femoratus*. Accordingly, *uniformis* is provisionally retained as a valid species in this genus.

S. constans, as recognized from specimens from the type locality comparing favorably with the original description by Walker (1851, p. 563) and with the illustration by Knight (Funkhouser, 1923, pl. 3, fig. 1), is not represented in the collection of the U. S. National Museum by specimens collected west of Iowa. Typical *constans* is suddenly replaced in central and southern Texas by a form that has a different type of style but similar aedeagus. This form is believed to represent a new subspecies.

SPISSISTILUS CONSTANS VARIANS, new subspecies

PLATE 22

Resembling typical *constans* but with the styles in the male more slender and elongate and the notch in the center of the posterior margin of the female last ventral segment broader.

Teeth on lateral valves strongly convergent apically, acute; bases less abruptly bulbous than in typical form. Apical portion of styles almost as long as posterior arm of aedeagus, curved dorsally; apices narrowly rounded. Posterior arm of aedeagus with three pairs of subbasal teeth; one pair projecting ventrally from ventral lip of functional orifice, one pair slightly dorsad and well laterad to the teeth on the functional orifice projecting laterad, and one small pair dorsad to latter pair projecting laterad. Last ventral female segment with broader notch in center of posterior margin than typical *constans* (Walker).

Holotype male (U.S.N.M. No. 57651) and paratype male from Concan, Tex., June 4, 1933 (Oman); allotype female and three female paratypes from Brownsville, Tex., May 31, 1933 (Oman); female paratype and two male paratypes, Brownwood, Tex., May 29, 1941 (Christensen); male paratype, Dallas, Tex., June 10, 1905 (Yothers), and female paratype same locality, June 11, 1907 (Pierce); one female paratype, Hearne, Tex., June 21, 1912 (Coad); two male paratypes, Kerrville, Tex., May 30, 1906 (Pratt); one female paratype, Valley View, Tex., June 31 (Beck and Hall); and one male paratype and one female paratype, Victoria, Tex., May 18, 1907 (Mitchell).

The known forms of the Western Hemisphere are listed below:

- constans* (Walker, 1851), new combination [*Thelia*, *Ceresa*]
- varians*, new subspecies
- cornutus* (Fowler, 1895), new combination [*Stictocephala*]
- femoratus* (Fairmaire, 1846), new combination [*Ceresa*]
- festinus* (Say, 1830), new combination [*Membracis*, *Thelia*, *Stictocephala*]
- dubius* (Fowler, 1895) [*Stictocephala*]
- fuscus* (Fowler, 1895), new synonymy [*Stictocephala*]
- franciscanus* (Stål, 1859), new combination [*Ceresa*, *Stictocephala*]
- nigricans* (Van Duzee, 1915), new synonymy [*Stictocephala*]
- occidentalis* (Funkhouser, 1915), new combination [*Ceresa*]
- rotundatus* (Stål, 1869), new combination [*Stictocephala*]
- uniformis* (Fairmaire, 1846), new combination [*Ceresa*, *Stictocephala*]

Genus STICTOLOBUS Metcalf

PLATE 19, FIGURE 11

Stictolobus METCALF, 1916, pp. 1-3.

Heretofore confused with the forms of *Tortistilus*, new genus, that occur on cypress but separated from that genus by the great reduction of size in the apical half of the styles and by the aedeagus lacking an

anterior arm. This genus includes the small, slender species with the suprahumeral usually developed into horns; however, the type species has the suprahumeral unarmed.

Metopidium almost vertical. Teeth of lateral valves longer than length of valves, usually curved dorsally or convergent apically. Sternal plate short, lacking notch on ventral margin apically. Styles greatly reduced in size in apical half. Aedeagus with anterior arm vestigial or not apparent; posterior arm with anteriorly directed apical hook; functional orifice elongate, extending from apex of aedeagus half the distance to the base.

Type of the genus, *Membracis subulata* Say (1831, p. 378), a species from the United States. *Ceresa vitulus minor* Fowler, actually a valid species, as stated by Buckton (1903, p. 171), occurs in southern Texas, and it is probable that varieties and subspecies of it occur southward into British Guiana. The interpretation of *minor* is based on Biologia Centrali-Americana material in the U. S. National Museum from Teapa, Tabasco; a species and a subspecies, previously confused with *minor*, are described as new from the United States. According to determined material in the Ball collection, *minutus* (Funkhouser) is a synonym of *subulatus* (Say).

STICTOLOBUS BOREALIS, new species

PLATE 23

Resembling *minor* (Fowler) but with much flatter metopidium and much shorter and stouter horns.

Length, male 6.8 mm., female 7.5 mm. General color amber mottled with white spots. Apices of horns and posterior process black. Two white lines originating on posterior side of each horn and extending caudad; ventral line following ventral margin of pronotum; dorsal line arched, following the contour of dorsal crest but located ventrally to crest; the two lines converging and ending on ventral margin of pronotum anterior to posterior process. Elytra yellowish apically.

Thorax low, little arched; metopidium vertical below suprahumeral; thence abruptly bent posteriorly above suprahumeral; humeral prominent; suprahumeral horns thick, obtuse, slightly recurved; posterior process long, declivent.

Teeth of lateral valves thickened in basal two-thirds; apical third stylate, abruptly curved dorsally. Sternal plate very deep apically; apex split. Apices of styles greatly reduced in size, paddle-shaped. Last ventral segment of female with posterior margin very broadly, deeply notched; sides of notch slightly sinuate.

Male holotype (U.S.N.M. No. 57652), two male paratypes, and one female paratype from Niobrara, Nebr., July 13, 1902 (Pierce); female allotype, two female paratypes, and male paratype from West Point, Nebr., "8-87"; two male paratypes from Rock County, Nebr.,

August 3, 1902, on oak (Pierce); and one female paratype, Carns, Nebr., July 24, 1902, on *Ambrosia* (Pierce).

STICTOLOBUS BOREALIS ARCUATUS, new subspecies

PLATE 23

Thorax much higher and more arched than in typical *borealis*. Teeth on lateral valves very suddenly narrowed in apical three-fifths and curved dorsally. Sternal plate shallow apically.

Male holotype (U.S.N.M. No. 57653) and paratype, Beeville, Tex., May 30, 1910 (Pierce).

The forms occurring within the United States are listed:

borealis, new species

arcuatus, new subspecies

minor (Fowler, 1895), new combination [*Ceresa*]

subulatus (Say, 1831)

minutus (Funkhouser, 1915), new synonymy [*Stictocephala*]

VESTISTILUS, new genus

PLATE 19, FIGURE 10

Intermediate between *Stictolobus* Metcalf and *Spissistilus*, new genus, in genital characters but differing from these genera by the over-all large size and by the short sternal plate which is greatly compressed laterally.

Pronotum highly arched; suprahumeral usually developed into long, stout horns but sometimes reduced to prominent protuberances; metopidium very broad. Lateral valves with teeth arising on ventral margins longer than length of valves; teeth flattened basally. Sternal plate compressed laterally, projecting ventrally. Styles vestigial or greatly reduced in apical half. Aedeagus with arms almost at right angle to each other; posterior arm much more elongate than anterior with the apex recurved or hooked anteriorly; sometimes with a pair of small basal spines; functional orifice subapical, small, ovate.

Type of the genus, *Ceresa ancora* Ball (1937, p. 479), a species from southern Arizona. As far as known this genus is limited primarily to Mexico and Central America. *Ceresa curvicornis* Funkhouser (1942, p. 181), described from a single female specimen from Arizona, is included because of its large size, broad metopidium, and strongly developed horns which are strongly suggestive of *ancora* Ball. A study of Biologia Centrali-Americana material in the collection of the U. S. National Museum indicates that *nigrovittatus* (Fowler) and *variabilis* (Fowler) belong in this genus. *V. vacca* (Fowler) is the common species in Mexico, according to Plummer (1935, p. 374), on authority of determinations by Funkhouser, but the most abundant form in the U. S. National Museum collection has been determined as *testaceus* (Fairmaire). This includes specimens from the Biologia

Centrali-Americana material determined by Fowler, and one specimen determined by Signoret. It would seem that either *testaceus* (Fairmaire) is unknown, that *vacca* is a synonym of *testaceus*, or that *mexicanus* (Plummer) is a synonym of *vacca*, but without examination of all the types it is impossible to settle this problem. It is best, therefore, that the species be retained as valid for the present.

The styles, though much reduced in size in this genus, still retain good specific characters which are best diagnosed by reference to the illustrations. (Pl. 19, fig. 10; pl. 23.)

The forms known to belong to this genus are listed.

- ancora* (Ball, 1937), new combination [*Ceresa*]
- curvicornis* (Funkhouser, 1942), new combination [*Ceresa*]
- mexicanus* (Plummer, 1935), new combination [*Ceresa*]
- nigrovittatus* (Fowler, 1895), new combination [*Ceresa*]
- testaceus* (Fairmaire, 1846), new combination [*Ceresa*]
- vacca* (Fowler, 1895), new combination [*Ceresa*]
- variabilis* (Fowler, 1895), new combination [*Ceresa*]

TRICHAETIPYGA, new genus

PLATE 19, FIGURE 9

Related to *Stictolobus* Metcalf with which it agrees in the small size and slender form but differs in the tripartite aedeagus.

Pronotum high, suprahumeral usually prominent and often developed into small acute horns. Lateral valves reduced to small membranous areas lacking teeth. Posterior margin of pygofer with paired processes on either side; a very short process on the apical fourth and an elongate projection at about the center of the posterior margin. Apical portion of styles vestigial. Aedeagus modified to form three arms with the ventroposterior arm bifurcate apically, bifurcate processes recurved laterally; central arm (or, normally, posterior arm) long, slender, sometimes with anteriorly directed apical hook; anterior arm short and broad in lateral aspect, sometimes much reduced in size.

Type of the genus, *Stictolobus juniperinus* Ball (1937, p. 481), a species from Arizona. As far as known only two other described species belong in this genus, *Ceresa infantilis* Ball (1937) from Guerrero, Mexico, and *Stictolobus delongi* Plummer (1943) from Morelos, Mexico. The ventroposterior arm of the aedeagus is very long in *juniperina* and extremely short in *delongi*. *T. infantilis* has a pair of anteriorly directed hooks on the central arm of the aedeagus (normal anterior arm) which the other two species lack.

The known forms are listed:

- delongi* (Plummer, 1943), new combination [*Stictolobus*]
- infantilis* (Ball, 1937), new combination [*Ceresa*]
- juniperina* (Ball, 1937), new combination [*Stictolobus*]

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ABBREVIATIONS USED ON PLATES

Each illustration bears the name of the species and is accompanied by key letters designating the structure that is illustrated. The key is as follows:

A=Aedeagus; left lateral aspect.

C=Aedeagus with style attached; left lateral aspect.

G=Genital capsule; left lateral aspect.

L=Style; left lateral aspect, usually of apical portion only.

O=Aedeagus; dorsal aspect of ventroposterior arm.

P=Aedeagus; posterior aspect, sometimes of apical portion only.

T=Tooth of lateral valve; left lateral aspect except *festinus*, which is from the posterior aspect.

V=Style; left ventral aspect, usually apical portion only.

Y=Lateral valve; left lateral aspect, sometimes with pygofer included.